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[Original Communication.]

Some Notes on the Chemistry of Gas Manufacture.

By Augustus A. Hayes.

[Continued from page 20.]

ANALYSIS OF COALS.

To give a technical value to the results of the analyses, the coals are decomposed under conditions like those of their application.

The testing of one or two grams having denoted the characters of expansion, alkaline, or acid state of products and general nature of the coal, the air-dried samples can be used for analysis.

A convenient apparatus is made from a porcelain crucible of 15 to 20 gram capacity, with a cover nicely ground to fit, and a condensing tube secured by grinding or by a platinum ferule, permitting refrigeration. As the weighings are best made with the crucible in air, it must be easily detached and may be counterpoised, so that the loss in each successive step may be known.

In this crucible from four to six grams of the sample may be heated in a current of air at 120° C. till vapor ceases to condense, the open end of the tube being immersed in water shows when expansion ceases. The loss of weight denotes the weight of moisture and gases held by the coal—a definite point for subsequent steps. The connection with the tube being made, a flexible tube and jet conveying coal gas is inserted into the tube, and the air displaced by coal gas, so as to provide a medium free from oxygen. The end of the tube being closed by water as before, heat is slowly and steadily increased by gas flame, until the commencement of change in the coal is indicated, by either naphtha vapor, aqueous vapor, or gas appearing, and the temperature being noted, the source of heat is removed, vessel cooled and weighed. The loss of weight above that at 120° C. denotes combined water in the coal, and is an important indication of its nature. In presence of air this point is indefinite, because oxidized humus increases its oxidation when heated in air, The sample of coal now dessicated is fitted for either of two modes of decomposition to be described.

By slowly raising the temperature of the crucible, while the freezing mixture cools, the tube, the end of which is immersed in water under a measure filled with water, at about 320° to 450° C. coals decompose, and the heat should be so maintained, that an even, continuous flow of gas is kept up, till it ceases at redness in daylight. On cooling the coke in the gas, by passing the tube above the water, its weight denotes the weight of coke which the coal affords.

This coke reduced to fine powder and consumed on a platinum test, leaves the weight of ash which the coke affords, and deducting from the weight of coke, we have the weight of what we usually call fixed carbon Strictly speaking this is not pure carbon, and a discrepancy which appears in this mode of analysis, when the results are compared with those of the elementary analysis may be noted here.

A given coal by elementary analysis—burning the carbon in oxygen—affords apparently less carbon than we obtain in most carefully conducted trials, the results sustained by large scale workings. This fact is founded on our inability to expel by heat alone, compounds which exist in coke. A coke which has passed down the high iron furnace, may contain five per cent less carbon than its weight indicates. In ordinary cases, either cylinder or heap coke retains compounds, which we can expel as gases—hydrogen being a large part—which give it a complex composition, and illustrate the fact early stated, that oxidized hydrocarbons in breaking up by heat, afford products with more and more carbon, but still retain hydrogen compounds. With this reserve in regard to other constituents in coke besides carbon, attention must be called to another misstatement. The ash truly represents in its weight after calcination, what we obtain in burning, but not the weight of the compounds, salts and other, existing in the coal, before decomposition. The ash becomes the reduced weight of the bases of salts, of sulphides, chlorides, and other bodies, while the higher oxidation of iron, manganese, and other bases diminishes the weight of carbon. These are fundamental errors, but they do not invalidate an iota, the claims of a practical method.

Turning to the products of decomposition of the coal, the weight being determined, we have the bodies which have been formed from the coal used, by slowly increased heat. The aqueous saline matters, the oily and crystalline, enable one to form a correct conclusion, respecting the value of the coal for producing oily condensable hydrocarbons.

The volume of the gas produced—its weight being left after determining the weight of coke and condensable substances nearly—and its proximate composition can be easily learned by using the ordinary tests. These characters studied more or less minutely, make up the existent features of the coal as developed in this way, but they do not give the gas manufacturer the precise knowledge his art requires.

In the observations of the action of heat on coal so far, it has been my intention to illustrate, by reference to experimental truths, the action of *slowly applied increasing heat*, and I might have called the operation that of *distilling coal*; a clear understanding of which throws light on the gas manufacture, and will be referred to as we proceed.

It was stated that one mode of analysis of coals was founded on the action of suddenly applied and continued high temperature. In passing to the study of the behaviour of coal under all the conditions named, but with that of heat rapidly applied, we enter the domain of highest interest to the gas manufacturer, making the production of gas the permanent features. In manipulating with coal gas, we may dispense with the usual machinery of gas analysis, and use of mercury for confining the gas.

River water which has been boiled, or water condensed from steam, thoroughly saturated at the working temperature with coal gas, and protected while in use by the slow escape of bubbles of the gas in the water, allows of accurate experiments; if acid gases be absorbed on their way to the store vessels. It allows us to use large vessels, and get perfect equalization of temperature, pressure and equality of mixture of gases and vapors.

In decomposing coal by the rapid application of heat, I have used a thimble-shaped vessel, its opening surrounded by an annular belt at an angle, forming a dip joint for containing melted lead. The cover was a hemispherical cap, through a reinforced part of which, the eduction pipe passed by a nicely cut screw, some inches long. The screw pipe reached near the bottom of the upright thimble, and on its length was a wire-gauze cage, containing clean fragments of dried and weighed coal. This apparatus permitted me to plunge the mass of coal into the already heated thimble, the edge of the cover dipping in the melted lead closed the thimble, and the eduction pipe at the same moment was connected with a pipe under the water jar. A gas furnace of massive parts raised the temperature of the thimble to bright redness before charging, and the mass of heated walls prevented cooling by the charge.

The intention of this apparatus was to get an approach to the conditions of an ordinary gas retort a moment after charging, supposing a pipe running horizontally through the centre to the back, and open instead of an ordinary stand-pipe...no other opening existing.

In decomposing coal by the slowly increasing temperature, we have seen certain results follow. If the conditions are all the same, and we apply the heat more rapidly, and shorten the time of distillation, we change the kind and quantity of the products. In general the volume of gas is greatly increased, the weight of the coke diminished, and the condensable products diminished also—a plain case of control in the hands of the chemist and manufacturer. The suggestion arising from such results is the possibility of converting a coal into coke, aqueous solutions of salts, sulphur compounds, gas, and vapors of simple hydrocarbons.

Proceeding by the steps indicated, we find as a constant result: that slowly heated, the charge affords the largest amount of condensable products, the smallest amount of gas; increase the rapidity of heating, the gas from a like charge is increased in volume, the weights of coke and condensable products are diminished.

Adopting the little apparatus described, so as to use heat suddenly applied, the coal breaks up into products named above, *without forming coal tar*—if the charge does not cool the retort and walls—and we have all the results of heating essentially modified.

Before pursuing this subject of the influence of heat on decomposing action further, it is my wish to support some of the facts stated by the results of analyses made of some coals, which have been chosen with reference to points embraced in these Notes, it being my wish that these results should take the place of verbal statements on points where possibly a difference of opinion may exist at present.

[To be continued.]

Wages in New York.

A *Tribune* reporter has investigated this subject, and gives the average wages of most occupations in New York city for January 1874: from which we select such as may interest our readers: For blacksmiths, from $2 to $2.50; brass finishers, $2 to $3 per day; brass-moulders, $3 to $4; boiler.makers, $2.50 to $3.50; boys, $2 to $5 per week; coopers, by day's work, average $3; by piece-work from $21 to $25 per week; coppersmith's average $3 per day, 10 hours' work; engineers, $2.50 to $3.50 per day; firemen, $10 to $14 per week; gas-fitters, $16 to $18 per week; gas works firemen average $3.50 per day: gas works helpers, $2.75: gas works laborers, $2; horse shoers, $3.50 to $4 per day of 10 hours; laborers (dock) $2; public works laborers, $1.75; park laborers, $1.75: machinists, $15 to $18 per week: plumbers, $3.50 for eight hours: porters, $10 to $20 per month with board; printers, day work, $22 per week; night work, $24 per week; printers in job offices, $20 per week; at newspaper piece work 45 cents to 55 cents per 1000 ems; stone-cutters, $4 for eight hours; ship-caulkers, $2 to $3.50 for nine hours; ship-carpenters, $3.50 to $4, nine hours; ship-carpenters in Navy-yard, $4.25: railroad men, $1.25 to $1.75 per day.

Election of Gas Officers.—A meeting of the stockholders of the Laclede Gas-Light Chmpany was held on Wednesday, January 14, and the following gentlemen were chosen directors for the ensuing year: Seymour L. Husted, Henry Y. Attrill, Charles Gibson, Rufus J. Lackland, Frederic Cromwell, John P. Van Bergen, Timothy H. Porter.

Mr. Cromwell stated that he wished to retire from the active management of the company, when the following were elected officers for the ensuing year: President, S. L. Husted; Vice-President, J. P. Van Bergen; Secretary, J. F. Macgovern.

Mr. Van Bergen, who takes Mr. Cromwell's place, will become a permanent resident of St. Louis, and will devote himself to the management of the company in connection with Mr. Macgovern, who still remains as Secretary.—*St. Louis Daily Democrat.*

Jersey City Gas Item.—The Committee of the Board of Public Works on Lamps and Light, has been instructed to confer with the City Attorney with a view to abrogate the contract with the Fayette Vapor Company. It is alleged that the street lamps lighted by said company have proved a failure, and in many cases were not lighted at all. The annual police report shows that during the past year 55,685 street-lamps, including 6,016 lighted by gas and 49,609 by oil were found unlighted.

The Gas Bill this Year.—The New York *Tribune* says: The old anti gas monopoly bill, which has been before every Legislature for the last ten years, and always failed to become a law, made its appearance again to-day (January 2nd), having been introduced by Assemblyman Donohue of Brooklyn. It provides that no gas company shall charge more than $2 per 1000 cubic feet of gas of 16 sperm candle illuminating power, and authorises the Mayors of New York and Brooklyn to appoint an inspector for each city, whose duty it shall be to test the quality of gas supplied to consumers at least once a week, and as much oftener as he shall be requested so to do by two or more victims of bad ges.

Chemical Repertory.

No. 106.—February 16, 1874.

EDITOR—HENRY WURTZ.

CHEMICAL EXCERPTS.

1001. Practical Mining—an Inch of Water.—D. R. (Brighton).—The miners' inch of water is a stream 1 in. thick, and would probably be about 20,000 gallons. The average price at the mines is about 10 cents, or 5d. It is only miners, however, who usually get the water at that price. For ordinary manufacturing purposes many are paying in the Western States at the rate of 3s. per 1000, and for domestic purposes as much as 7s. 6d. ($1.83) per gallon is sometimes paid.—*London Mining Journal.*

1002. Sensible Ballunacy.—We learn from the newspapers that there has lately arrived from Paris and is now in this city an immense balloon, which will be taken in a few days to San Francisco, where it is to be used for makihg scientific ascensions.

1003. Compressed Air Motors.—The invention of Messrs. Bushnell and Merriman, of New Haven, Connecticut, relates to an improvement in that class of engines which are driven by compressed air or other gaseous medium, and it consists in injecting into the escape from the engine a jet of hot air sufficient to prevent the freezing of the moisture in the escaping air.

1004. Aluminum for Burners.—J. Kidd, of 27 Leadenhall street, London, has patented improvements in gas burners, which consist in the application to argand or other burners of aluminum pure and alloyed, together with an adjustable check valve to the burner which regulates the light.

10005. Petroleum-Fire in a Gas-Works.—The Mutual Co., as is well-known, commenced by using naphtha, the danger of which is undeniable. They now use common crude petroleum. Result as follows, as recorded in the daily papers:

On December 31st an oil tank at the Mutual Gas Company's at Avenue D and Eleventh street caught fire and caused some apprehension for the safety of the works. The oil, however, burned out and the fire was confined to the tank, with a loss of $50.

1006. Light-Houses.—A new hydraulic float-lamp, as it is called, has been placed in the lighthouse at Atlantic City, and is said to be greatly superior to the French mechanical lamp just removed. With this illuminator the lamplighter is able to give a perfect four-inch flame, just double what the other did. It consumes two and a half gallons of lard oil per night, and has four large concentric wicks, the largest of which is three and a half inches in diameter.

1007. Good Idea.—The new army boot, introduced into the English service by Sir William Palliser, a distinguished English soldier, gives general satisfaction after undergoing a severe trial by several regiments, both at home and abroad. One feature of the boot consists in placing two thin slabs of cork, reaching from toe to heel, underneath the inner sole of the boot, which renders the sole quite impervious to wet. The object of employing two slabs is in order that the cork in one slab may cover any flaw which may exist in the other.

1008. What are "Wallsend Coals."—In consequence of certain coal dealers being brought before the magistrates for selling as "Wallsend" coal of other descriptions, Messrs Cockerell have taken the opportunity to explain that the term "Wallsend" was originally descriptive of the coal drawn from the spot where the old Roman wall ends on the northern side of the Tyne. For the last 50 years past the term "best Wallsend" has applied to certain coals ranking as the most valuable for household purposes, and is, in that respect, as distinctive a term as it ever was. Anyone ordering "best Wallsend" should be secure of obtaining Lambton's, Hetton's, Original Hartlepool, Tees, or Wallsend coals ranking with these, and certified as such by the factor on the London market. —*London Mining Journal.*

1009. British Gas-Patent.—G. T. Livesey, South Metropolitan Gas Works, Old Kent Road, Surrey. Improvements in apparatus used in the manufacture of gas. These have for their object the reduction of the pressure upon the retort caused by the seal of the dip-pipe, and consist in a dip-pipe having a horizontal slot made in it at or near the level of the liquid in the hydraulic, and sufficiently large to allow of the gas passing freely away This slot is covered by a plate or flap so suspended from above that it falls by gravitation over the opening. When the retort is at work, the valve is raised by the pressure of the gas or action of the exhauster, but as soon as the retort is open the flap falls, the liquid rises in the dip, and an effectual seal is formed. When necessary, the bottom of the tap can be closed.

1010. Oleaginous.—The *Oilman's Journal* tells us that the daily production of the oil region is now placed at 32,000 barrels, and that there are fewer wells now drilling in the Lower Oil Region than there has ever been since developments commenced.

From another source we learn that Titusville, Pa., has 11 petroleum refineries, and from the progress made in the last few years, she expects to be eventually at the head of that branch of the oil industry.

The *Titusville Herald* says there are upwards of 2,000,000 gallons of crude oil in tanks at that point, with absolutely no protection against fire.

During the year 1873, the Erie Railway has received an average of about $90,000 a month for transporting petroleum over its road from the oil regions to the seaboard.

It is calculated that it would require ten times the number of wells to be sunk in Butler county in 1874 that were sunk in 1873 to produce the same amount of oil. The limits of the two belts are now clearly defined, and the fourth sand only exists where the belts cross.

1011. "Heavy Oil" on Hand.—There are at the present time, in what is known as the Franklin oil district, about 100 psoducing wells, producing an average of about five barrels of heavy oil per day. There is a stock of this oil at the wells, and in Franklin, of about forty thousand barrels, exclusive of twenty-five thousand barrels held by one party, which can be fairly considered out of the market, as its owner holds it at about five dollars a barrel. Most of this forty thousand barrels is held at two dollars a barrel, and the producers are discussing the propriety of stopping their wells for sixty or ninety days, to permit the accumulated stock to work off. If this should be done this oil will undonbtedly advance very soon. —*National Oil Journal*, for December.

1012. New Patent Coffee Pot.—John F. Weber and Peter Knutson, La Crosse, Wis.—The pot is composed of three different sections—the upper or water receptacle, the middle one, into which the gas, alcohol, or coal oil lamp is placed, and the lower receptacle, for the coffee or other articles which are intended to be boiled. The lower part is detachable, and the coffee, tea, etc., placed therein. The upper receptacle is filled with water, closed tightly, and the lamp then lighted. The generation of the steam forces the boiling water up through a tube to a glass bulb, and then through a smaller tube and strainer, to the lower part, extracting the strength of the coffee. The lamp is then extinguished, and the liquid slowly drawn up again into the water receptacle. The process is repeated, if the coffee is desired to be very strong. The glass bulb or tube indicates, by the passage of the liquid through it, the different stages

of the cooking process. The coffee is then drawn off for use.

1013. English Petroleum Stoves.—Messrs. Wright and Butler have introduced a very simply constructed economic petroleum heating-stove, which consists of flat wick burners placed under a bronzed cylinder. A kettle can be placed on the top, if necessary, by simply removing the dome. It will be remembered that we some time ago reported upon an inspection of a model of this new stove, when we expressed an opinion that it could be improved in a few points of importance. We are pleased to say this has since been done, and a good petroleum stove is now produced, which we understand is coming largely into demand. A very simple portable stove for heating a kettle or saucepan is also made by this firm, and will prove useful in every household.—*Ironmonger.*

1014. Aniline Colors.—Professor Kopp, who has recently made a careful study of the aniline colors at the Vienna Exposition, says that the manufacture of these pigments from coal tar products is making most remarkable progress. Fuchsine, constituted by a salt of rosaniline, is obtained exclusively by the reaction of arsenic acid on commercial aniline. In order to afford an idea of the enormous consumption of this violent poison in the manufacture of fuchsine, it is stated that in Germany alone the same is estimated at 3,3000,000 pounds a year. It is only lately that the residues have been treated to regain the arsenic in commercial form. Mr. Kopp mentions as a novelty a beautiful rose red coloring matter called saffranine, which upon silk is a very brilliant dye.—*Scientific American.*

1015. Interesting Explosion.—Last year we had an explosion of a very disastrous character, of flour mixed with air, which led to the burning of an immense amount of mill property in London. From the Pacific coast we have now an account of a similar phenomenon from mixture of coal, or rather liguite dust with air.

A serious accident occurred in one of the coal mines at Nortonville, on Saturday afternoon. The dust arising from the coal dumped at the bottom of the three hundred-foot chute ignited from a lamp and exploded instantaneously. Nine men in all were burned: D. Ferguson, dangerously, Ed. Williams, Jas. Landrum, Demartine and others.

1016. A Chicago Pastoral.—As the charming Nilsson has taken to keeping cows in her Peoria retirement, one of the "Lake Poets" has broken out with the following sublime eruption, in which this and that are put together in a way altogether worthy of an "American humorist" or any other man:

"Christine, Christine, thy milking do, the morn and eve between, and not by the dim religious light of the fitful kerosene. For the cow may plunge, and the lamp explode, and the fire fiend ride the gale, and shriek the knell of the burning town in the glow of the molten pail."

1017. Spread of Certain Diseases.—It is to be regarded as a settled fact that diseases of a contagious nature are caused and spread by influences largely within the sphere of our control. This fact has been strongly urged by Dr. Symes Thompson, a well-known English physician, in a lecture delivered by him in London. Every form of infectious fever, he asserts, has its idiosyncrasy. Thus, enteric fever and cholera tend chiefly to disseminate themselves through water passing into the wells and fountains of daily supply; scarlet fever hibernates in a drawer, and, after long months, comes forth with some old and cast-aside garment, to be thrown with it around the throat or head of some new victim, and so start thence upon a fresh career; typhus fever crawls sluggishly from hand to hand and mouth to mouth; typhoid fever generates itself where filth and impure habits of life prevail. So well known are these idiosyncrasies, and the means of control, that the existence or spread of such diseases is directly attributable to neglect of the most simple laws of prevention.

1018. Synthesis of Anthracene and of Dimethyl Anthracene.—W. A. van Dorp.—Benzyl-toluole, prepared according to Zincke's directions, and having a constant boiling point of from 275° to 277°, was passed through an ignited tube filled with pumice stone, and became converted into anthracene, which when pressed and re-crystallized from glacial acetic acid is pure. It melts at 213°, and contains—

Carbon	94·38
Hydrogen	5.86

It was capable of conversion into anthrachinone and alizarine by the ordinary methods.—*Liebig's Annalen.*

1019. Hydrogen and Carbon in Coal Gas Distilled at Different Temperatures.—

Temperature.	Hydrogen	Carbon.	Name of Gas.
Dull red heat	100	614	Principall oi'fia't gas (C_4H_4)
Red heat	100	580	
Bright red heat	100	472	Olefiant gas mix ed with m'sh g.
White heat	100	325	Marsh gas C_2H_4.
Continued white heat	100	7	Nearly pure H. carbon depos't'd.

—*T. Wills, F. C. S.*

1020. Burning Hydrocarbons. (Am. Patent.)—Charles H. Cushing, Tidioute, Pa.—A heavy circular iron pan has a raised outer rim, and a less raised inner rim, around a small central orifice through which the steam or air blast is admitted from a suitable conduit pipe. The oil or other fluid is admitted through an orifice in the outer rim, and its supply regulated by means of a stopcock on the oil conducting pipe. The oil will flow from the orifice over the pan and fill the same to the height of the inner rim over which the surplus will flow, to be thence carried up by the steam or air blast coming through the orifice. The fluid is thereby divided into fine particles and thrown, intermixed with steam or air, against the top and bottom of the boiler, ready for almost instantaneous combustion.

1021. Caking Coal-Slack, for Fuel.—The practicability of the following plan, from an Iowa correspondent of the *Scientific American*, is doubtless complete in that section, and others where corn is sufficiently cheap; that is, supposing coal to be simultaneously dear. As slack is only abundant, however, in mining districts, where coal is cheap, it seems as if circumstances favorable to such operations as this could not often occur.

To the Editor of the Scientific American—

I notice several articles in your journal on the preparation of slack or waste coal for fuel, and would suggest a plan for its preparation, especially applicable to this great Northwest, where coal is dear and corn cheap:

Grind very fine one-half bushel of corn, boil it in one barrel of water until it is like prepared starch. Mix it with one tun of fine coal dust in a mortar bed: as soon as it is stiff, cut it out, and pile under cover to season. As a fuel, this cannot be beaten.

Richard Long.

1022. Important to Snakes.—An English exchange says that carbolic acid is a deadly poison to snakes, and experiments have proved that a few drops are sufficient to cause almost instant death to the dreaded cobra, and suggests that it might be invaluable in India and other tropical countries.

Chemistry of Ice.—Mr. John Aitken has observed that after the same water had been melted and frozen a number of times, it generally burst the tube in which it was frozen. This he explains on the hypothesis that ice containing air is viscous and adapts itself to the form of the vessel; by repeated freezings the air is removed, and the pure ice, being less or but little viscous, will not so easily adapt itself to the enclosing walls.—*Sci. Press.*

American Water-Gas Researches.

[Continued from page 22, No. 2.]

OBJECTS OF, AND MODE OF CONDUCTING THE RESEARCH.

The object of this research upon the new form of hydrocarbon process, has been to test the merits of the method as developed by its practical working, on a sufficiently large scale, and with various kinds of coals; and to give the whole subject generally such investigation as its general practical importance demands. To do this satisfactorily, it was essential that a considerable amount of analytical work should be undertaken in connection with the processes of manufacture. Some interesting points of equal practical and theoretical importance could be reached in no other way. And it is believed by us that the examination of the results stated in this paper will show that the solution of these questions has proved of unexpected interest and importance, going far, it is believed, toward settling the moot questions involved.

In order to obtain results which would satisfy gas engineers, it was important to have control of some gas-works, where the experiments essential to testing all the points at issue might be carried out on a working scale, without the disturbing influences which are inseparable from the conduct of such an investigation, when made in connection with any active gas-works where the ordinary coal-gas process is in use at the same time. Arrangements were therefore made with the New Haven Gas Light Company for the exclusive use of a small work of four benches, owned by them in the suburb of Fair Haven. These works had lain idle for some time, had been but little used, and were designed to produce about 40,000 cubic feet of gas daily. The gas-holder has about that capacity, and the general plan of the works is such as is usual for dry lime purification. A photometric room was arranged near the station meter, and a gas laboratory fitted up with all the needful apparatus on the premises. The necessary changes to convert the works into the form required for your plans were commenced in July, 1868, under the supervision of your superintendent, Mr. G. W. Harris, one of the inventors. Unexpected mechanical difficulties, arising mainly from the disuse of the works for a considerable period, caused much delay in the development of the process, and it was only in November that Mr. Harris was prepared to turn the works over to us for experimental purposes.

[Since December 1st all the operations and records have been under my supervision, and have remained so until the end of March. About the 1st of December the valuable services of Prof. Henry Wurtz, of New York, a well-known chemist, and familiar with gas-making, were secured, and I desire here to acknowledge my great obligations for the efficiency, zeal, and ingenuity which his long experience in such matters enabled him to bring to bear on this research. —B. Silliman.]

ARRANGEMENT OF THE APPARATUS.

Two benches of three clay retorts each were prepared. The upper retort, charged with 860 pounds of Pennsylvania anthracite, was nine feet long by 30 inches wide and 16 inches high. After inserting the cellular bottom for distribution of the superheated steam, these dimensions were contracted to 27 by 13 inches.

The bituminous coal charges were from 200 to 250 pounds to each bituminous retort, of such coals as are subsequently specified.

On very rich coals, like Boghead, Albert, Peytona, and other cannel coals, the charges were reduced to 100 pounds, or even less.

The hydrocarbon gases (hydrogen and carbonic oxide) were allowed to flow for two hours upon each fresh bituminous charge, alternately from one retort to the other. The whole period of carbonization was within four hours, and was often with advantage reduced to three and a half hours, and for very rich cannels to less.

With a view to determine the best mode of admitting the hydrocarbon gases to the bituminous coal re-

torts, one bench was so arranged that these gases might be sent at pleasure in three ways, viz.:

1. Through the bituminous coal retort, and back through a top flue constructed over the retort to the stand pipes.*

2. Through the top flue just named into the rear end of the retort containing the bituminous coals, and then up through the mouth-piece.

3. Directly into the mouth piece, where a commingling of the hydrocarbon gas with the bituminous coal distillate occurred, and thence through the standpipes to the hydraulic main.

It was also possible, of course, to employ either bench at pleasure in the ordinary dry method of carbonizing.

All three of these methods of management of the products of decomposition have been tested by a variety of experiments, the details of which need not be given here; but practically, nearly all the working results detailed in this report were obtained by the third method named above. This method appears to secure most of the substantial advantages sought. The hot gases of the anthracite retorts seize upon and exalt to a permanent gaseous condition an amount of hydrocarbon vapors sufficient to give to the resulting product the same illuminating power which belongs to the bituminous mixture employed when carbonized in the dry way under the most favorable circumstances: and the volume of the total product is increased by the addition of an amount equal to an increase of 50 per cent. of the volume. Thus a ton of Westmoreland coal, with 10 per ct. of Albertite added as an enriching material, which carbonized dry yields an average of 4.10 to 4.20 cubic feet, or say 9.200 to 9,400 feet per ton, of 18 to 20 candle gas, yields by this treatment 14.200 cubic feet of gas of the same candle power. See the tables at close of this document for details. This is equivalent to over 19,000 cubic feet of 15 candle gas, the usual standard of illumination in most American cities.

When the arrangement of retorts is, as it was at Fair Haven, in benches of *threes*, and the upper one is the anthracite retort, the amount of water-gas produced is sufficient to raise the product of the whole bench to 15,000 or 18,000 cubic feet in twenty-four hours, which, allowing 5,000 feet as the product of each bituminous coal retort on a four hours' shift, leaves at least 7,000 feet for the joint product of the decomposition of water and vaporization of the hydrocarbon vapors which would otherwise find their way into the coal tar. The measured quantity of tar, by this process, is as nearly as possible nine gallons per ton of coals carbonized, while the same coals carbonized dry yield somewhat over eleven gallons, leaving a little over two gallons per ton, as the quantity which is permanently vaporized to form part of the perfected gas.

The coke produced when the bench is managed as now described, is quite sufficient to burn off the charges when good caking coals are used, and in a large work would leave a small surplus.†

With the exclusive use of cannel coals, producing no coke, or that of little value, and requiring a large volume of water gas to bring them down to the common standard of illumination, coke must, of course, be supplied from some other source. So long, therefore, as the volume of gas sought to be produced does not require more than *one third* the number of retorts heated, to furnish the hydrogen, the amount of coke produced will more than suffice to heat the benches.

Our experiments at Fair Haven, in the large way, were restricted chiefly to the class of caking coals, with different enriching materials added in proportion of 5 per cent, to 20 per cent. of the mass: for the reason that in the United States the comparative high cost of good gas coals renders it important to the manufacturer to produce as much gas as possible from a given weight of coal, consistent with maintaining the standard of illuminating power. This standard is usually 16 candle, more rarely it is 18 to 20 candles, quite as often it is 14 to 15 candles. All gas engineers will agree that it is a very good caking coal which, with a 16 candle power and *used alone*, will furnish an average of 10,000 cubic feet of purified gas. It is certain that very few ever reach these figures, and with 10,000 feet to the ton the illuminating power rarely exceeds 15 candles. That few gas works attain this standard even, during the whole year, few will deny, who are competent to express an opinion. We have, therefore, thought it best to guide our researches, in view of the great practical importance of attaining a yield of 15,000 cubic feet of 16 to 18 candle gas, using coals universally recognized as the best available to American gas engineers, and employing in connection with them very moderate quantities of such enriching materials as are within the reach of all. The results are given in detail in the records appended, and to which more particular attention will be directed hereafter.

At the same time, some attention has been given to the use of the rich cannels, and especially to the Peytona of West Virginia, which is certainly one of the best American cannel coals known, yielding over 10,000 cubic feet of 42 candle gas to the ton, and 13,200 cubic feet of 32.66 candles, by ordinary treatment. By the hydrocarbon process an average of 22,400 cubic feet of 23.25 candle power, and a net gain of 124 per cent. of total economical effect, was obtained from this coal. See Table II, on page 53, for details. This coal is one of several of similar character found in Western Virginia, but appears to be much the best which has yet been opened.

The photometric measurements were made daily on the gas in the holder, after the lime purification, by Bunsen's photometer, with all the usual precautions and corrections.

For the rich cannel coals with charges of 100 pounds each, the method pursued was to test the gas for photometric power at the end of the first hour, after the amount of the charge and when rather over one-half the total yield had been registered; in these cases the gas was drawn of course from the main, after it had passed the station meter, and was on its way to the holder. Such tests, extending for fifteen or twenty minutes beyond the first hour, gave in general closely accordant results, and in point of illuminating power are certainly *not above* the average yield of the charge.

The eudiometrical analyses were made:

(1.) Upon the products of the anthracite retorts, drawn from an outlet in the mouth-piece before these gases mingled with the products from the bituminous coal retorts.

(2.) On the purified and perfected gas from the holder.

(3.) On the gas from the New Haven Gas-Light Company, made from identical materials during the periods of comparison.

The experimental details and modifications of the usual methods of gas analysis which have been employed in these investigations, are reserved for a separate memoir, to be published ere long in the scientific journals. In this connection such details are out of place, being of interest chiefly to analytical chemists.

[To be continued.]

* This form of retort involves the essential features of the so-called "diaphragm retort" of White's process, often mentioned by Dr. Frankland. But experience has convinced us that it may with advantage be replaced by the ordinary simple form of clay retort, and if a separate hydrogen flue is required there is a much simpler way of obtaining it, which we have communicated to the inventors.

† See the chapter on the cost of gas by the hydrocarbon process, page 61, for further details on this point.

Correspondence.

[Correspondents, in all cases, should sign their communications with their names and address in full—not necessarily for publication, but as a guarantee of good faith.—Ed.

Rises to Explain—About Naphthaline.

Newport, R. I., Feb. 9th, 1874.

Mr. Editor: In my poor little suggestion in relation to naphthaline, published in your issue of September 16th, I tried to say that in my experience I found the pipes around the works, and even those in the streets, sometimes obstructed with naphthaline, when the gas was treated to a copious shower of cold water on entering or emerging from the condenser. But when treated to a gentle washing with ammonia water, the tendency of the pipes, etc., to become thus obstructed was arrested.

I said "a copious shower of cold water just as the gas enters or emerges from the condensers, seems to be very healthy for naphthaline, and frequently develops it strong and abundant." I thought every one would understand my meaning to be, that so showering it developed its capacity for obstructing the pipes and drips, and that the conditions which were "healthy" for naphthaline were unhealthy for the engineer, by reason of the annoyanee caused by the result.

I think if Mr. Cathels will again read the paragraph wherein the above quotation occurs, he can scarcely fail to see how he has reversed my meaning. In his first paper he raps me for asserting what I had not the remotest intention of saying. On the contrary the troublesome experience of gas engineers hereabouts who have used spray washers of great water capacity have prepared them to accept the belief that much washing is "healthy for naphthaline."

Having thus corrected Mr. Cathels's misquotation of my views as to the treatment of the gas containing naphthaline vapors, I leave this branch of the subject with a reference to the suggestion made by Mr. Walker in the last number of the Journal, that "increased condensation" was an ineffectual remedy, but that slow travel with friction would effect a cure of the naphthaline trouble, and by adding my cordial endorsement to his conclusion.

I am not yet prepared, however, to abandon my theory as to the origin of naphthaline in the retorts, much less to accept Mr. Cathels's suggestion that it is formed more abundantly at the end than at the beginning of a charge. Has any one succeeded in condensing it with bromine or chlorine from the last end of a charge? Mr. Cathels does not believe that a clay retort is rapidly cooled by the rapid evaporation of the gas at the beginning of a charge. If he will take off a lid in from seven to ten minutes after closing it, and quickly draw out the coal, he will easily see that the interior heat is very much lowered.

W. A. S.

Burning Tar for Fuel.

Covington, Kentucky, Feb. 5, 1874.

Mr. Editor: Noticing several articles in late numbers of your paper, in reference to the use of coal tar for heating the retorts in gas works, perhaps a little more on the subject may be of interest.

Mr. Richard Salter, the efficient Superintendent of the Covington gas works, has adapted a bench of threes to this purpose, with *no additional cost*, as follows:

When resetting the bench with new retorts, he *built in* a tile eighteen inches long, and slanting from the centre of the fire door, backward and downward, at an angle of fifteen degrees; the iron door was dispensed with and its place walled up with brick, a small sight-hole box being inserted just level with the highest point of the tile.

Above the fire door a small opening admitted a sheet-iron trough, or open gutter—one inch of its lower and smaller end being within the oven, and about three inches outside. To start the bench temporary grate bars were placed just above the ashpan, and upon these a *coke* fire was kept for several days till the oven was heated; then the tar was turned on and the coke fire left to die out, all air below being excluded by a sheet-iron plate in front.

The pipe conveying the tar passes down several inches from the front of the bench, and has a small globe valve attached to it. From this the tar falls in a small stream upon the outer end of the trough (above mentioned). Thence running into the oven it drips upon the tile, meeting there the air through the open sight-hole box, and is consumed, the consequent heat passing around the retorts and up the flue.

In this manner an excellent *yellow* heat has been maintained, and *very little* smoke is emitted.

At first an elevated two-barrel tank was filled daily from a cistern; but in cold weather the tar was too thick to run well, so the *hydraulic main was tapped*, and the tar now used requires no handling, and has been running steadily for a month only two benches of fives and one of threes are attached to this main.

The oven requires no attention, except to scrape the tar cinders off the tile every six hours—a minute each time sufficing.

Mr. Salter has estimated a barrel of tar thus used equivalent to fifteen bushels of coke; so parties in different localities can make their own estimates in regard to economy.

Lewis Collins.

Destruction of Leathers of Diaphragms in Dry Meters.

Carlinville, Ill., Feb 5, 1874.

Mr. Editor: Will any of your readers inform me through the Journal, the cause of and remedy for destruction of leathers of diaphragms in dry meters, where petroleum or naphtha gas is used?

Inquirer.

Second Chemical and Sanitary Report upon the Water Supply of the Cities of Newark and Jersey City, in New Jersey.

By Professor Henry Wurtz.

[Continued from page 42.]

II.—THE RIVER ABOVE THE FALLS.

The sample collected July 24, above the falls (No. 9), will do well to compare with the series collected on the previous day in the lower basin. In appearance it was beautifully limpid, this limpidity being due to the long, still, deep and shady two-mile reach just above the falls, which acts as a settling reservoir. I may here throw in the suggestion that the canal—were it to be taken by your Honorable Commission as an aqueduct, and the continued wash against the banks, from the boats, thus ended—would do a like work with this extended lagoon above the falls, and its water would quickly become equally limpid and translucent. On proceeding up stream towards Little Falls, as soon as the lagoon was passed and the water began to ripple (which is somewhere about the Midland Railway Viaduct), it was seen to be opalescent, so that the bottom could scarce be discerned at one foot depth; the impurities from the factories and dwellings at and about Little Falls becoming perceptible to the eye, as well as to the smell and taste.

The analysis in Table III (No. 9), furnishes an idea of the changes impressed on the water by passing through the cities of Paterson, Passaic, etc. It may be compared, for this purpose, with the mean of the two low-tide samples, Nos. 2 and 4, as well as with some of the figures of No, 2 directly.

TABLE III.

Numbers.	SAMPLES	Total solids.	Loss on incineration.	Ash.	Nitric Acid.	Saltpetre equivalent.	Ammonia from animal matter.	"Albumenoid" matters.	Chlorine.	Common salt equivalent.
9	Passaic River—head of Falls—July 24	4.584	1.501	3.083	0.334	0.624	0.023	0.234	0.252	0.416
2&4	Mean of two Low-tide samples at Belleville	5.431	1.140	4.291	0.303	0.567	0.049	0.496	0.274	0.452
2	Low tide sample at Newark Works	.....	.....	.....	0.233	0.433	0.087	0.875	0.332	0.547

TABLE IV.

Illustrating the successive changes of Passaic Water, while flowing from the Falls at Paterson to and through Newark, and back again through Belleville with the rising tide—during the Summer season.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Number.	SAMPLES.	Total solid Constituents.	Loss on Incineration in Porcelain.	Ash.	Nitric Acid.	Saltpetre, equivalent to the nitric acid	Combined Ammonia.	Urea, equivalent to the combined Ammonia.	Ammonia derived from matters of Animal origin.	"Albumenoids" (by Wanklyn and Chapman's hypothesis)	Chlorine.	Common salt, equivalent to the chlorine.
9	Water of Passaic Falls—July 24	4.584	1 501	3.083	0.334	0.624	———	———	0.023	0.234	0.252	0.416
2	Low tide at Newark Water Works—July 23	5.455	1.105	4.350	0.233	0.433	0.023	0.041	0.087	0.875	0.332	0.547
4	" Jersey City Water Works—July 23	5.407	1.175	4.232	0.374	0.700	———	———	0.012	0.117	0.216	0.356
16	River in Newark—just before ebb—August 20	5.249	1.575	3.674	0.187	0.350	0.058	0.103	0.117	1.167	———	———
17	" " " just after flow began—August 20	5.833	1.458	4.375	0.037	0 070	0.029	0.052	0.292	2.916	———	———
3	High tide at Jersey city Water Works—July 23	6.178	0.722	5.456	0.374	0.700	———	———	0.029	0.292	0.288	0.476
1	" Newark " " " "	5.995	0.647	5.348	0.278	0.520	0.012	0.021	———	———	0.433	0.713

TABLE V.

SAMPLES.	Total Solids.	Loss on Incineration.	Ash.	Nitric acid.	Saltpetre.	Combined Ammonia.	Urea equivalent.	Ammonia, of animal origin.	"Albumenoid" matters.	Chlorine.	Common salt.
Water of Passaic Falls	4.584	1.501	3.083	0.334	0.624	undet'r'd	undet'r'd	0.022	0.234	0.252	0.416
Morris Canal, above Pompton Feeder	4 231	0.881	3.350	0.186	0.347	none	none	none	none	0.144	0.238

TABLE VI.

SAMPLES.	Total solids.	Loss on Incineration.	Ash.	Nitric Acid.	Saltpetre, equivalent.	Combined Ammonia.	Urea equivalent.	Ammonia, of animal origin.	"Albumenoid," matters	Chlorine.	Common salt, equivalent
Water of Pompton Plains Feeder	3.332	0.764	2.568	0.139	0.260	0.003	0.005	0.029	0.292	0.115	0.190
Calculated composition of long level below feeder	3.781	0.822	2.959	0.162	0.303	0.001	0.002	0.014	0.146	0.129	0.214
Water of Reach, above Falls	4.584	1.501	3.083	0.334	0.624	.....	.....	0.023	0.234	0.252	0.416

It appears, therefore, that the Belleville water averages a grain more per gallon of total solids, and about a grain and a quarter more of mineral matter, derived from town sewage, than that above the falls, but that the silt precipitated by the sewage below the falls, or some other agency, makes away with 0·36 grain of the organic matter present. The nitrates are less at Belleville, through action of vegetation in the stream below the falls. The "albumenoids" however, notwithstanding the constant absorption by weeds and fish, are more than doubled, and if we take the result in the low-tide water alone, at the Newark works, nearly quadrupled. The chlorine also undergoes a marked increase, as it inevitably must from sewage contamination, from 0·252 to 0·332 in the low-tide Newark water.

Nevertheless, it must be frankly said that this analysis of the water of the falls at Paterson by no means justifies the estimate that the people of that pleasant city appear to entertain of the purity of their water supply; but rather agrees with what might be expected of a stream, one of whose tributaries (the "main" Passaic) comes down from a thickly populated agricultural country, full of towns and villages; and runs, moreover, through a large swampy district (the "Great Piece Meadows"), frequently inundated.

In order to follow out the successive changes of the composition of the stream in its course through the lower basin, from the falls through Paterson and Passaic, through Newark, and back with the rising tide through Newark again up to Belleville, I have constructed Table IV, which, however, it must be remembered, does not furnish a strict comparison, as the samples in the city of Newark were taken nearly a month later in the summer than the others. This table, however, will repay attentive study.

A gradual increase appears in total solids and in the dissolved mineral matter, in consequence of influx of sewage. The rising tide shows less of nearly every ingredient at the Newark works than at the Jersey City works below, doubtless in consequence of greater admixture with the down-flowing water of the stream itself. This does not hold as to the chlorine, however, which is increased in proportion by this admixture with the water from above, conveying the excreta of the large population of men and animals on the banks.

The nitrates are very variable, in consequence, as

already explained, of variable action of vegetation in different parts of the stream, combined with the constant development of these nitrates by oxidation. There is a large increase of dissolved animal matter from the falls to the Newark works, which doubtless contributes to support the fish that densely populate the stream at and above Belleville, and which, therefore, dwindles down rapidly, until enormously reinforced at Newark, and then again dwindles down to nothing—partly consumed by fish, but also by vegetation and oxidation—during the up-flow. The effect of oxidation is manifest, during this up-flow, on examining the nitric acid—(column 5), which shows a maximum in the up-tide at the Jersey City works, and then a rapid diminution again, through vegetative action. Examination also of column 3 illustrates the same surprising changes—the amount of volatile and combustible matter, notwithstanding the Paterson and other sewage, actually diminishing from the falls down to the water-works, and the maximum of these ingredients—in the channel at Newark just before ebb, 1.575 grains—running down rapidly during the flow up to the Newark water-works to only 0.647 grain. The rapidity of these alterations is here most astonishingly exhibited; and I would throw out the suggestion (or rather, on my own part, the conviction) that we owe our health (such as we have) and probably our lives, during the summer season at least, to the concurrent action of these three causes, animal and vegetable life, and oxidation. Should any one, and especially any two, of these fail us, the consequences may readily be conjectured. At some time, as may be confidently predicted, both the plants and fish will fail us. The very excess of nourishment that we now provide for these living things may at any time lead to their sudden or rapid extinction, as, in fact, it already has at other points in the river.

III.—THE CANAL—THE LONG LEVEL.

On the occasion referred to above, of the excursion to Beavertown, the water of the canal was examined and tested at several points. It was found to be more or less turbid, from the constant wash of the banks. The taste of the water opposite Little Falls appeared to be of an earthy or clayey character, very slight, and probably due to the same cause as the turbidity. This taste I was unable to perceive at the point near Beavertown, where our sample was collected, which is, I should add, on the same level (the "seventeen-mile level"),

It will be observed that the results of the analysis of this sample compare much to its advantage with that of the Passaic Falls, there being a trifle more of mineral matter, however, which is no important objection. (See Table V.)

This, moreover, does not tell the whole story, for the canal, after taking in below, upon this same level, the water of the Pompton feeder, which is much purer still, must change its composition very considerably for the better. In the next paragraph this will be again referred to.

IV.—THE POMPTON PLAINS FEEDER.

As this feeder may be made to bring down the whole of the waters of the Pequannock, the Ramapo, the Wynockie, and the Ringwood, including the water of Greenwood Lake—comprising certainly more than one-third of the whole Passaic water-shed, while coming from a country far less populated and cultivated than the Croton shed—it appeared to me of the utmost importance to examine it well. It will be seen that the results of the analysis fully sustained the expectations formed. Table VI gives these results by themselves, together with a calculation of the composition of the water of the long level above Paterson, which extends to Bloomfield, on the supposition that the main canal and this feeder bring down equal quantities of water.* I repeat again, for comparison, the composition of the falls. (See Table VI.)

It would certainly be possible to supply all the low-lying business parts of your two cities (which consume all but a small fraction of the water-supply), through the long level, from this feeder alone, for an almost indefinite time to come, with what is clearly one of the purest waters in the United States. I am here, however, probably intruding somewhat on the engineering questions, which do not lie within my province.

Whether this feeder, or the main canal, or any part thereof, be made use of to obtain the proposed water-supply, I have to point out that there are many places along both where the embankments are not continuous, and where small portions of the adjacent land are overflowed, and where shallow pools are accordingly formed, necessarily more or less stagnant, and full of growing and decaying vegetable matter. Such should all be carefully diked off by well puddled embankments.

* It is, nevertheless, proper to add, that the amount of the purer water *obtainable* through the feeder is greatly in excess of that which the main canal can bring; probably, indeed, nearly three times as great, so that a far larger allowance than the above may justly be made on the side of purity from the admixture.

V.—THE ROCKAWAY RIVER.

This stream runs through three towns of some size, Dover, Rockaway and Boonton. A smaller place also, Denville, imparts its drainage. Beginning with Boonton, I do not know whether the canal receives, on the level below the Boonton plane, any of the drainage of lower Boonton, but if so, this can easily be directed into the lower Rockaway. The main difficulty appears to be above Boonton, at Powerville, where the canal crosses and coalesces with the stream, the latter being brought up to the level of the formed by the dam at that place. Thus the canal is made to partake of such contaminations as are brought down from the towns and population of the valley above. Whether by extinguishing the Powerville water-rights, and removing the dam, the two could be separated at this point, and the river conducted under the canal, is a question for the engineers to decide. The stream, between Powerville and Dover, when observed during July, was seen to be opalescent and particularly offensive to the smell and taste, but during September it was perfectly limpid, inodorous and tasteless. The result of the analysis of the Passaic Falls should teach us, however, not to trust too much to such external appearances. Inquiry in Dover elicited the fact that the citizens who occupy the thickly-settled river-bottom are greatly dissatisfied with their *wells*, attributing much sickness to bad water. A few words on this head will not be out of place. It may be asserted that the wells, in a river valley filled with porous material, belong to the river itself, and partake of its current. The stream frequently—particularly in a dry season—will run more underground than on the surface; which is proved by the familiar fact that it will often disappear for distances more or less great, leaving the channel dry, and reappear again in the channel below with its regular current. It is plain, when we consider this, that all drainage, all liquids of every kind from privies, open sewers, rain, etc., that soak into such a soil, become at once part of the flowing subterranean stream, and will flow *through the wells* themselves. The only variation in effect from the throwing of such effete liquids directly into the stream, is that in the latter case they have some chance of being consumed and rendered innoxious by oxygen, fish and vegetation, but, in the other case, little or none. These simple facts might, could and should, be taught to children in schools. Increase of population throughout country towns and villages will, probably, in time, cause the iron hand of necessity to be felt, and lead to increase of knowledge in these matters.

It is presumed that the canal when passing Dover, can easily be kept separate from the Rockaway, and that such water as shall be taken in from the stream may be derived from above that town, where the Rockaway is, unmistakeably, a pure mountain stream, coming down in two branches from wild and unsettled districts—one from the Longwood Valley and the other from Denmark Valley and Green Lake, a lake which is the highest water in the State (1,044 feet above tide, or 130 feet higher than Lake Hopatcong). No sample was secured from this upper Rockaway, as it was assumed that it would be identical with the water of Lake Hopatcong, with whose tributaries some of its own interlace. This is now a subject of regret, as the Hopatcong water was found by the analysis, to possess a certain peculiarity, as set forth below.

VI.—LAKE HOPATCONG.

As before stated, the visit to Lake Hopatcong was made upon a day which had been preceded (the night before) by a tremendous rain, which raised the level of the lake two inches, according to the statement of the lock-keeper at the feeder.

It was, therefore, thought interesting to take, in addition to the sample from the gate by the lock into the feeder, another sample from the margin of the lake, to determine the effect of the wash from the soil of the surrounding country. It will be observed (No. 6) that this marginal water had a very different composition from that of the bosom of the lake.

With regard to the latter, it may be interesting to compare the total solid contents with that of a few other lakes.

Lake Hopatcong	1.79
Bala Lake, Wales	1.63
Loch Katrine (supplies Glasgow)	1.63
Norwich Conn., Reservoir	1.84
Cochituate Lake	3.11
Lough Vartry, Ireland (supplies Dublin)	3.11
Croton Lake	4.78
Geneva Lake, Switzerland	8.87
Lake Ontario	6.01
Lake Erie	6.49
Lake Michigan	6.68

[The analysis of Bala Lake, in Wales, here quoted from, was made by Frankland and Odling. Another analyst, R. H. Smith (possibly at a different season) obtained a very different result—2.65 grains per U. S. gallon; and of this latter no less than 0.589 was chlorine—more than five times that in Lake Hopatcong. The Rhine, at Basle, in Switzerland, fed by the drainage of the Alps and the melting glaciers, while containing 9.88 grains of total dissolved matters per U. S. gallon, has but 0.077 of chlorine. This is the purest natural water, so far as chlorine is concerned, that I have ever heard of. It will be seen that Hopatcong approaches it—containing but 0.014 grain more per gallon.]

These few examples are sufficient to show that this water is among the purest of lake waters. But still, on examining the figures of the analysis, a strange anomaly appears. I refer to the existence of *nitrates* in this mountain lake, in what may be called a large proportion. Of the fact there can be no shadow of doubt. The figures given are the mean of three wall-concurrent analyses on three separate portions of the sample, collected by myself and sealed up in a chemically clean glass-stoppered bottle, and never opened until the analyses were begun. The presence and origin of these nitrates in Lake Hopatcong are mysteries to me at present. The only supposition I can make is that they exist in the water in the form of what are called nitro-humates, derived from peaty or decomposing *vegetable* matter. This is totally at war with the passage from Frankland, quoted on a previous page. It is to be borne in mind that, however produced, these nitrates are perfectly innocuous, and, in such minute quantities indeed, perfectly inert. The idea of their derivation from animal matter (unless from *dead fish*—an inadmissible idea) seems preposterous, and the possibility of drainage contamination in this lake, even if a supposable case, is negatived by the other figures obtained (See columns 9, 10, 11, and 12, of Table I).

I observe that in an analysis of Loch Katrine, cited by Wanklyn and Chapman, the nitrogen existing as nitrates is given at 0.00031 milligramme per litre, equal to 0.06 grain of nitric acid per U. S. gallon. This is but one-sixth that in Hopatcong, but shows, nevertheless, that a mountain lake *may* contain nitrates. In any case the nitrate test is proved, in the case of mountain lakes and streams, in this country at least, to be of no use as *positive* evidence of sewage contamination, though *negatively* it may still be of value.

I have already stated, generally, the view to which my field and laboratory work jointly have impelled me, regarding a gravity low-service supply for your two cities, for the low-lying portions, where the main supply for business, manufacturing and steam purposes—as well as for fires, is required. I shall now say, that both Science and Nature appear to me to point clearly—as the source of a *high-service* supply of water from the hills, among the purest in the world, for drinking, washing, and cooking uses, sufficient for all time, for Bergen Hill and the higher parts of Newark—to the elevated district comprising the united water-sheds of Lake Hopatcong and the upper Rockaway, above Dover. I have carefully marked out and measured the joint area of these two water sheds. It forms a somewhat regular oblong parallelogram, 12 miles by six, or seventy-two square miles—which would give an average daily supply, the year round, of fully eighty million gallons. One month's flow, or less, during seasons of flood, would fill a reservoir as large as the new and huge croton reservoir at Boyd's Corners, which might be located somewhere among the hills about Boonton or Montville, and to which the Hopatcong water and the Rockawny above Dover, could be conducted through the canal. The piping required to take the water from such a reservoir to Belleville would be about sixteen miles in length, as the crow flies.

[To be concluded in our next.]

Stove-Gas.

Seventy Children rendered insensible by stove gas in a school-room.—Susquehanna Depot, Pa., December 12.—Seventy children attending school at Oakland, a little village near here, had a narrow escape from suffocation from stove-gas on Tuesday morning. The presence of the poison in the air was not known to the teacher until about eleven o'clock, when the smaller children began to drop from their seats to the floor, where they lay unconscious. The teacher then, greatly alarmed, announced the dismissal of school, but not over half the scholars could get out of their seats, and the remainder rapidly fell into unconsciousness. As quickly as possible they were dragged into the air and laid on the ground. A few of them revived on getting into the air, but twenty-five remained unconscious. A physician was summoned, who succeeded, after long and persistent efforts, in reviving all of them. One little girl was three hours insensible. If they had remained in the school-room but very little longer, half of them at least would have been past all relief. Several are yet very sick from the effects of the gas. The foul air was driven into the room by the stove pipe having by some means been jammed against the back of the chimney, preventing draught.—*N. Y. World.*

Carbonic Acid not a Poison, but Oxygen a Poison.

For some time the opinion has become prevalent among many chemists that most cases of poisoning usually ascribed to carbonic acid CO_2 are due to carbonic oxide CO, the product of imperfect combustion of coal. It is argued, 1st. That if carbonic acid were a poison we would continually be inhaling a poisoned atmosphere, as good air always normally contains one-tenth of one per cent of this substance, and may contain much more without being injurious to the system. 2d. That the cause of the unpleasant effect of air in a close room after having been breathed by many persons present in the same, is due to other exhalations—perspiration, flavors, etc., of the different constitutions, and not to the carbonic acid. 3rd. That pure carbonic acid only intoxicates, and in this way makes the persons insensible, while when they are made to breathe pure air afterward no unpleasant effects remain. 4th. That death in those cases of committing suicide by means of a furnace of burning charcoal in a close bed-room is caused by the carbonic oxide produced by the imperfect combustion of the charcoal by the insufficient amount of oxygen in the room, and not by the carbonic acid—carbonic oxide being acknowledged as a virulent poison, of which the presence in the air in a quantity of less than one-fiftieth of one per cent causes a series of alarming symptoms.

As a companion to this change of opinion comes the announcement of M. P. Bert, who has found that when pure oxygen is inhaled under a pressure of four atmospheres, or more, it becomes a most virulent poison; while common air breathed under a pressure of twenty atmospheres kills not so much by the mechanical effect of an increase of pressure, to which an animal soon accommodates itself, but to the concentration of the oxygen present in the air to a bulk so small that twenty times as much comes in contact with the surface of the pulmonary cells, as is the case in the normal condition. —*Dr. Van der Weyde.*

[The editor of this Journal must be allowed to add that in his own case, speaking as a chemist, no "change of opinion" has occurred on the point of the non-toxical nature of carbonic acid; as he is not able to remember the time when he was willing to admit it to be a poison, in the true sense of that term. He has, in this Journal, repeatedly expressed this opinion. See, for example, issue of July 2, 1872, p. 2.—H. W.]

Leaden Water Pipes.

M. Belgrand, the able director of the water and sewage service of the city of Paris, said that the number of persons who paid for a supply of water in their houses in Paris was 40,000; and, taking the average length of the service pipes at 40 metres, the total length of the service-pipes would be about 1,600,000 metres—just a thousand miles. The replacement of this length of pipe would cost a large amount of money; still if the necessity existed it must be done; but there really did not exist the slightest danger from the use of lead pipes.

Experiments had been made in the laboratory of the engineer charged with the testing of theil luminating power of gas, and the following are the results:

In operating with five litres of water concentrated by evaporation, the most sensitive tests did not denote the existence of salts of lead. It is true that distilled water has an active effect on lead, forming carbonate of lead, but it only requires an infinitesimal quantity of carbonate of lime in the water to prevent it acting on lead, and all the water used in Paris is in this condition, even rain water, which meets in the atmosphere with lime, in the form of powder, in sufficient quantities to prevent action on lead. This fact serves to explain why leaden pipes last to an almost indefinite period, while cast or wrought iron pipes are worn out in a few years.

There remain still some leaden conduits in Paris of the epoch of Philippe Auguste, which, if the water had any effect upon them, would by this time have been pierced like a sieve.

The authorities do not in any way oppose the use of pipes lined with tin; but they present the disadvantage of being dearer than the ordinary kind, and, moreover, the presence of tin causes asperities where the soldering has taken place, which favor obstructions in the pipes.

Errata.

In our last issue there were unluckily a number of these, to which we must call attention.

—In Excerpt 995, line 7, for 5.53, read 3.53, and line 8, for 55 read 35.

—In Excerpt 999, "New England" should have been Kew, Australia.

—In Excerpt 1000, last line, the figures as they stand being inscrutable, the line might as well be expunged altogether.

—In the sentence appended to Mr. Williams Insurance Circular to Gas Companies, the word "lot," in the first line was written *list*, and corrected in the proof, but the types were inexorable. This was a "bad lot." It made the Editor's own lot seem hard.

—Page 41, middle column, 12th line from top, for "31st" read 13th.

—Page 41, Table I, No. 16, for "3 P. M." read 1 P. M.

—*Ibid*, Table II, column 11, for the figures given under "Chlorine," substitute 0.151, 0.292, 0.216, and 0.152.

—Page 42, middle column, lines 35, 36, and 37 from top, erase sentence repeated twice.

—*Ibid*, Under "Correspondence," for "Jacksonville, Albany," substitute Jacksonville, Ill.

—Page 44, middle column, line 30 from bottom, for "Wm. D. Rogers" read Wm. B. Rogers.

—*Ibid*, line 36 from bottom, for "carbonate" read carbonite.

—*Ibid*, third column, line 25 from top, after "Silver Islet" supply and; line 41 from top, after "quantity of" supply tin; line 49 from top, for "1862" read 1872.

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MONDAY, FEBRUARY 16, 1874.

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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GAS-FUEL VERSUS COKE.

The duty of a journalist is in part to put topics of current public interest in every point of view, before his readers of all classes; and we would fain hope that among its readers the journal has both consumers and producers of gas, though the former are in number smaller than we deserve and ought to have—chiefly in consequence of a sheer lack of knowledge on the part of the public of our existence. Humiliating as this is to confess, conscious merit nevertheless prevents us from being much cast down. It is *their* loss, not *our* fault.

Still, as we have readers among gas consumers, advice and suggestion from us about use of gas for fuel is not altogether in vain. Now there are numerous points to be considered in this connection that do not come up in the popular articles now so often swinging around the circle of the technical journals and newspapers. Two or three of these it is borne upon our mind to glance at.

It is seldom considered—except possibly by some of the more thinking men connected with gas production—that the incoming of gas fuel will decrease the consumption of coke, in cities; and that there is here therefore an argument that will offset, to some greater or less extent, the advantages to the producer of an increased consumption of gas, as fuel.

This point concerns more directly the producer, and we shall revert to it again hereafter, from his point of view. At present we mention it to introduce some ideas that should interest the consumer. Why, then, is it that gas-fuel and coke-fuel are in a measure rivals? Is it not that they both present us similar advantages? Both are quickly kindled, without much labor. With either, a hot fire can be quickly got up without using up a large mass of material. Both will kindle and burn on without much artificial draft, and so on. Both are therefore well adapted for domestic use, especially in warm weather, in small households.

Now when a gas producer—or when we ourselves (who, as we trust, produce nothing of the sort) argue with intelligent consumers, in favor of gas-fuel, for its especial fitnesses, the replies are that it is all very true, undeniable, and so forth, but think of the impossibility of preventing lavish use by servants and so on; and then, after all, you cannot prove but that, at prevailing prices, your gas, for the same amount of calorific power, must cost us much more than coal.

As to the lavish-use objection, we have always maintained that this applies to all fuel alike, and that with gas, it will be far more easy for the party whose pocket is interested to detect, control, and prevent such waste, than in the case of coal or other prevailing fuel.

As to the question of cost per calorific unit, it is here the coke-consideration comes in. Revert to the above-enumerated advantages of coke and gas. Does not the latter of the two far surpass the former in every one of these advantages? Now we propose to show that, in the case of coke, these advantages counterbalance a cost for equal heat, of more than double that of coal. Saward's *Coal Circular*, a wholly disinterested authority, tells us, in a late issue, that—"The relative costs of coal and coke for like results, as developed by an experiment in a locomotive boiler, are as 1 to 2·4; and, as for coke—

"Its evaporative power, in the furnace of a steam-boiler and under pressure, is from 7½ to 8½ lbs. of fresh water per pound of coke."

Yet no coke-consumer will abjure coke on this account.

Let us again repeat, that the strongest real practical argument—of the kind which we only fully appreciate after time and experience have drilled it into us—an argument which has eminent applicability in this land of ours—in favor of a large application of gas for fuel, is the *saving of servile labor* that it will bring. A household needing two servants (say at $300 each per year, including subsistence) will, during seven months in the year, get on with one) a clear saving of $185 per year, to set against the gas bills. This will make some consumers open their eyes doubtless, but it is a very moderate calculation. In numberless families this alone will overbalance the greater money-cost of the gas; and all the other invaluable comforts it is going to bring with it, will be clear gain. More anon. It may be thought that this is not the season to think of this, but we think it is. This is a case where it would be well in time of war to prepare for peace.

FLOW OF GAS THROUGH PIPES.

Morris, Tasker & Co. have favored us with another valuable *brochure*, prepared, as we presume, by their accomplished Engineer, Mr. Munzinger, on the above subject. This contains 33 pages of highly useful tables, calculated with much obvious labor, together with the various formulæ necessary for such calculations; which latter are discussed in a shape apparently more compact, manageable and conveniently available, than by Pole, in the Chapter on this subject incorporated into our editions of Clegg.

We are obliged to point out, however, to the learned author, that in a most important point, that is, in setting forth the fundamental empirical formula from which the others are deduced, the types have played him an apparently unobserved trick. The expression the square root of $\frac{h\,d}{s\,l}$ in Pole's formula, having become $\frac{\sqrt{h\,d}}{s\,l}$, which is a very different thing. This puzzled us at first, but that it is but a typographical error became clear on going over the calculations, which are correctly in accordance with Pole's expression. We therefore call attention to this, to prevent others from having the trouble we had. Mr. Munzinger says that recent experiments "appear to give an average of about 15 per cent less discharge than is indicated by the formula. This would require an alteration of the constant 1350 to 1150. But as the experiments were made only on one pipe, it would be desirable that more experiments upon pipes of various dimensions should be made before altering the formula."

Let us recall in this connection a paper read to the last June meeting of the British Assoc'n of Gas Managers, on this highly important subject, by Mr. Paterson. This gentleman, after a general review of the history of the subject, came to the conclusion that a modification of the coefficient 1350 was not called for, and he considers Pole's article in Clegg, except two slight errors, "the most valuable elucidation of the subject which has yet appeared, and a safe and reliable guide in the hands of the gas engineer."

LIQUID FUELS, TAR AND PETROLEUM

Our various correspondents still keep up the interesting discussion regarding the use of tar as fuel under the retorts. So long as there is no remunerative market for the huge quantities of tar produced, this is an important question, and there are too many towns in the United States where such a market does not offer. In time this will mend almost everywhere, and it will

pay better to sell the tar than to burn it for fuel. The topic, therefore, is not of very enduring importance.

It may be, however, that the collection of the experiences of all, in the tar-fuel business, may help us in a work which impending, that is may teach us the best way to manipulate in burning petroleum for fuel. Certainly, within a given radius—by no means a small radius—from the oleigenous centres, petroleum is going to be, for many purposes, a fuel of great cheapness, convenience and adaptability to special and very important uses. This radius will extend enormously with the extension of lines of piping, or petroleoducts.

It may probably be asserted that where it will pay to use petroleum for making gas, either *per se*, or for enrichment of coal-gas, it will pay to use it as fuel for many important applications. Considering this, and putting this and and that together, a deduction of importance follows, which is probably here enounced for the first time. This is, that petroleum-gas retorts should be heated with petroleum. We here dispose at the same time of the coke question, which is a frequent bugbear of the advocates of petroleum for gas-making. That is, the question as to where the coke is to come from for heating the gas retorts, if gas coal is altogether dispensed with, and no coke made.

It follows that our discussion of tar-fuel for gas-retorts should be carefully followed up, by those who are experimenting on petroleum both for gas and for fuel purposes.

CATHELS ON SETTING AND WORKING RETORTS.

At the meeting of the British Association of Gas Managers, in June, 1870, Mr. Cathels, now of Montreal, Canada, read a Memoir on the above subject, which many of our readers will doubtless retain some recollection of, as we gave it in full in the columns of this Journal, appreciating both the great importance of the general subject, and the learned and lucid treatment of it by Mr. Cathels (See this Journal for August 2d and 16th and September 2d and 16th, 1870).

We have now to announce that Mr. Cathels has wisely—for convenience of reference, and in order to append his drawings—republished this treatise for distribution in pamphlet form. This document is for sale by the publishers of this Journal (as *vide* advertisement on this page).

The author of this treatise thinks—and none who know will say him nay—that "the retort-house is the most important part of the factory." A thought or two on this will do none of us any harm. The Retort-House is the place where the gas is *born*. Both its quantity and quality depend upon the treatment that the coal—its egg—receives initially in this place of incubation. If the volume or body—the quantity or quality—of the gas, be wanting at its first parturition, unfortunately we do not find any resemblance to other fledglings—if sickly or puny when born, it will not grow, under any skill of nursing. Nothing in our processes of condensation, defecation, or purification, will help us. Gas must be hatched from its nest full grown and full fledged.

Not to pursue this rather fantastic comparison, it is sufficient to say that in the eyes of the practical gas maker, it is the retort which *makes the money* for him. In view of this, Mr. Cathels has "given retort setting and working a great deal of attention," and believes that the results of his experience and observation, largely embodied in the pamphlet spoken of, will be of use to all others who follow the same pursuit. The whole of the profession in any case, should obviously take the opportunity he offers, to acquaint themselves with the plans he has matured and embodied here in the form of drawings and specifications.

It will be observed also that Mr. C. advertises to supply drawings in further detail, specimens of which we have had the good fortune to inspect, as prepared for one of our largest gas-light companies. These, even were there room to do so, we should not presume to try to describe critically, but rather advise each engineer to procure for himself these very fine tracings. From our own examination we are convinced that they involve some points, the adoption of which would bring decided advantage to many of our American gas works.

Mr. C., in correspondence with us, in referring to points wherein he deems that we Yankees could do better than we do, speaks especially of working double length, or through and through retorts, charged at both ends simultaneously, which he believes have not been tried here, and which he is persuaded would give us not less than 15 per cent. more gas with 15 per cent less fuel, and not become encrusted with carbon. This persuasion of Mr. C's would appear to be justified by the experience of at least one of our large companies, that now uses this setting, the New Haven Gas-Light Company. We learn, from private correspondence with Prof. Silliman that these retorts yield them now 4·7 feet of gas per pound of coal, doing well in all other respects.

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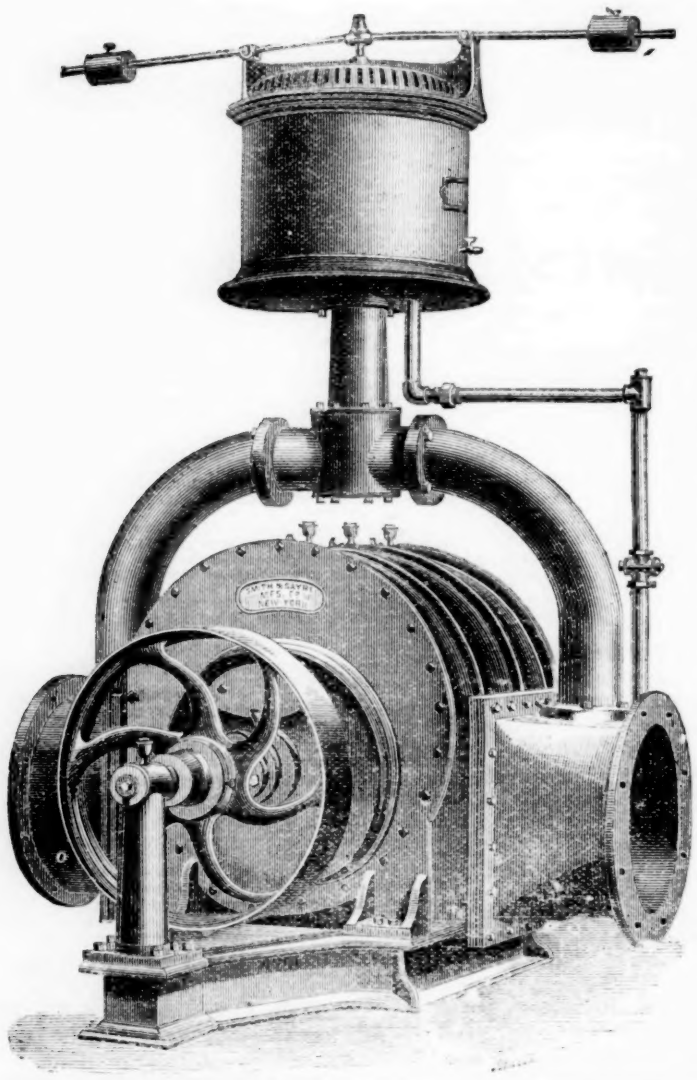

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Dear Sir: The Trays manufactured by you for our West Station were put in use in September last, and have *given perfect satisfaction.*

The frames are well put together, and I see no reason why ey will not last for a long time. The *very large amount of space* in these Trays gives the gas an easy passage, and brings it into contact with the lime much better than when the space is so contracted, as is the case in most of the other Trays in use.

The pressure thrown upon the retorts by contracted passages is very great, and were gauges used more frequently than they now are in many gas-works, this facat of having *open Trays* would become more apparent to mangers of gas works. The digerence in pressure at this station in passing the gas through your purifiers, is two-tenths (2-10) inches.

The amount of gas purified, per bushel of lime used to this date, is six thousand five hundred and fifty six (6,556) cubic feet.

Respectfully yonrs,
JAMES H. ARMINGTON, Supt.

BOSTON GAS-LIGHT CO., Dec. 1871.

Dear Sir: In answer to your inquiry how we like your Patent Tray for dry gas purifiers, I take pleasure in saying we have used them exclusive of all others, for the last three years, and think them far ahead of any yet offered. The surface being nearly three times that of any other Tray, and their lightness and durability perfectly satisfactory.

Yours respectfully,
A. M. GILES.

EDWARD DUFFEE, Esq.

EAST BOSTON, JUNE 15, 1871.

Gentlemen: We have used your Screens some five years. They give perfect satisfaction.

I consider them *by far the best Screen* for Dry Lime Purifiers I have seen. Yours truly, A. M. NORTON, Supt.

CHELSEA, May 1, 1871.

Mr. E. DUFFEE.

We are using your Purifying Trays, and find them to be the *best of any* that I have used, and will *purify more gas with less pressure* than any tray that I know. I can fully recommend them, after four years trial, to any Gas Superintendent with perfect safety, as the *cheapest and best Tray made.*

Yours truly, JOHN ANDREW, Sup't.

DORCHESTER, March 3, 1870.

Mr. E. DUFFEE.

Dear Sir: We have had your Gas Trays in constant use for almost one year and six months and find them superior to any others we have ever used, both in point of economy and efficiency. Truly yours, W. B. BROOKS,
Agent Dorchester Gas-Light Co.

JAMAICA PLAINS, MASS., June 21, 1871.

EDWARD DUFFEE, ESQ.

Dear Sir; The Trays ordered by this company three years ago, are getting somewhat worn. I wish to say here that I consider your Trays to be superior to any yet invented, therefore please make us another set at the price named, to be like the sample shown in every way, and oblige Yours truly
JAMES F. ROGERS,
Sup't Jamaica Plains Gas-Light Co.

BROOKLINE, June 11, 1871.

E. DUFFEE, ESQ.

Dear Sir: You will please make a set of Gas Trays for this company as soon as convenient, at price named. In regard to the merits of the Tray, after having them in constant use for over two years, I will say that I consider them *superior to any Tray* manufactured in this country. Respectfully yours,
H. A. ALLYN,
Sup't Brookline Gas-Light Co.

BANGOR, August 2, 1870

EDWARD DUFFEE, ESQ.

Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted. Respectfully yours,
W. H. PERRY, Sup't.

OFFICE OF THE SPRINGFIELD GAS-LIGHT CO.
SPRINGFIELD, MASS., Oct. 10, 1871.

Mr. WARD,
President Hartford Gas-Light Co.

Dear Sir: I have been using Gas Screens made by the American Gas Screen Company, for nearly a year, and find them superior in every way to the wooden Screens made and formerly used by the Springfield Gas-Light Co. I can purify more gas with the same quantity of lime, there being more surface to the Screens; and I consider them more durable, and recommend them to your consideration.

Yours with great respect,
GEORGE DWIGHT.

ROXBURY, June 14, 1872.

EDW. DUFFEE, ESQ.

Dear Sir: In answer to your inquiry regarding your Patent Gas Screens, I am happy to be able to say, that after nearly three years constant use we are perfectly satisfied with them being able to purify over fifty pet cent. more gas with them, than with any other Screen we have used.

Yours respectfully,
THOMAS J. PISHOU

OFFICE DETROIT GAS-LIGHT CO.,
DETROIT, MICH., April 22, 1872.

AMERICAN GAS SCREEN MANUFACTURING CO., HAVERHILL.

Gentlemen: The Screens bought of you work far better than any we have ever used. As a proof, we have with the same quantity of lime purified *twenty per cent.* more gas with your Screens than with any others, and the work well done. The workmen are also better pleased with them—they being light and handy to work. They also relieve the pressure very much upon the retorts, and I cheerfully give yau my experience.

Yours truly,
P. E. DEMILL, Secretary.

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Amer. Gas Screen Man'f'g Co., Haverhill, Mass
EDWARD DUFFEE, Agent.

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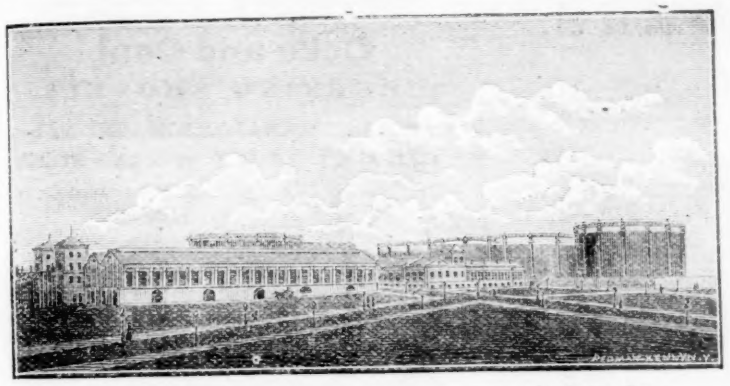
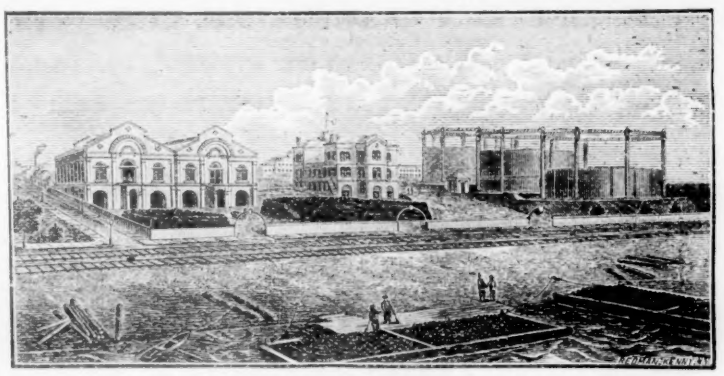


CINCINNATI GAS WORKS. ERECTED 1871-72-73.—WM. FARMER, ENG.



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Exhausters for Gas and Foul Lime Ventilation,
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NEW IRON COMPOSITION

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Cost 70 cents per bushel. One bushel for each square foot of Purifier sufficient. Rights to use for life of Patents, for daily makes of gas in thousands; under 25,000 $200; under 50,000, $400; under 100,000, $500; $250 additional for each additional 50,000 per day.

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☞ Immediate arrangements are urged, as the demand for e prepared composition is increasing *so rapidly* that delays supply may occur.

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Gas and Water Mains.

All sizes from 3 to 30 inch cast vertically in 12½ feet lengths

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From the Sterling Colliery.

We are now prepared to place in the market, through our agents as below, a regular and unlimited supply of this valuable Cannel, for gas purposes. The analysis made in 1871 by Prof. WURTZ, Editor of this Journal, at the Laboratories of the NEW YORK GAS-LIGHT COMPANY, gave 47½ per cent of Volatile Matter and 45 bushels to the ton of a fair quality of coke. The yield of gas was at the rate of 9,500 feet per ton of about 27 candle power. It is not highly sulphurous, can be purified by Lime, and the ash from the coke does not clinker. The above test has been fully substantiated as correct, and can confidently recommend trial of the coal.

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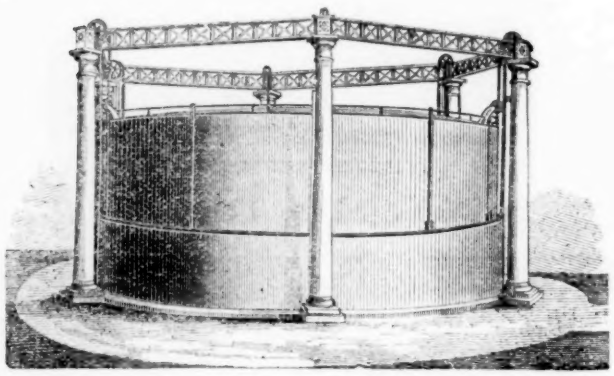

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37-3m

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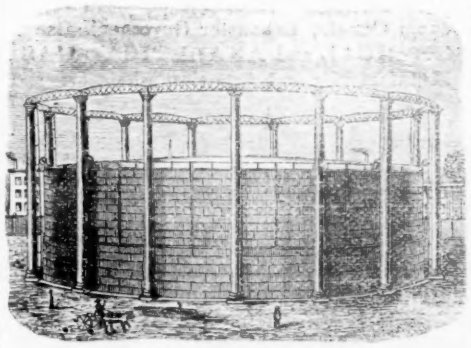

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252-1y

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It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

The best dry coals shipped, and the promptest attention given to orders. 294-1y.

LUDLOW Valve Manf'g Co.,

OFFICE AND WORKS

938 to 954 River Street and 67 to 83 Vail Ave.,

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Make Valves (Double and Single Gate ½ inch to 36 inch—outside and inside screws, Indicator etc.) for Gas, Water and Steam—also

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We would refer to the following among many other Companies using them:

GAS-LIGHT COMPANIES.

Metropolitan, New York; Manhattan N. Y.; Buffalo, N. Y.; Brooklyn N.Y., Rochester, N. Y.; Philadelphia, Pa. New Orleans, La.; Cincinnati, Ohio; Cleveland, Ohio; Columbus, Ohio Chicago, Ill.: Quincy, Ill.; Springfield Mass. Milwaukee, Wis. St. Louis Mo.; Louisville, Ky.; Memphis, Tenn. Galveston, Texas.

WATER COMPANIES.

Burlington, Vt.; Keene, N. H.; Concord, N. H.; Springfield, Mass; Worcester, Mass.; Buffalo, N. Y.; Auburn, N. Y.; Utica, N. Y.; Troy, N. Y.; Philadelphia, Pa.; Cincinnati Ohio, Cleveland, Ohio; Dayton, Ohio; Peoria, Ill.; Detroit, Mich.; St. Paul. Minn.; New Orleans, La.; Memphis, Tenn.

MURRAY & BAKER,

Practical Builders.

And Contractors for the Erection of Gas Works,

MANUFACTURERS OF ALL THE LATEST AND MOST IMPROVED APPARATUS AND TOOLS FOR THE MANUFACTURE & DISTRIBUTION OF COAL GAS.

☞ WORKS AT THE RAILWAY DEPOTS,

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We manufacture Bench Castings, Washers, "The Immersed Multitubular," and Atmospheric Condensers, Wet and Dry-Lime Purifiers, Dry Center Seals, Telescopic and Single Gas Holders, Wrought Iron Trussed Roof for Iron or Slate, Wood and Iron Trays for Purifiers, Coke and Coal Carts, Wrought Iron Screening Shovels and Castings, and Wrought Work of every description for Gas-Works.

As Mr. Murray is a Practical Draughtsman, we will furnish plans and specifications to parties or associations, or will wait personally upon parties contemplating the construction of new works, or the alteration or extension of old ones

The most satisfactory references can be given, if required of the experience and commercial fairness which character izes our dealings.

We would respectfully invite Western mento call and see our patterns and works here. MURRAY & BAKER,
198-1y Fort Wayne, Indiana.

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No. 4 Warren Street, New York.

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This Company is the owner of the GWYNNE-HARRIS, or AMERICAN HYDROCARBON process, for making Gas for Lighttng or Heating purposes, by the perfect decomposition of superheated steam, under what is known as the

GWYNNE AND HARRIS PATENTS.

This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

The process can be put into either Coal or Oil Gas Works (or where both Coal and Oil are used) at small cost, without any interruption to the working of other benches. The Citizens Gas-Light Company of Brooklyn, after using it for more than seven months, have found it not only far better, but actually *cheaper* than atmospheric air in making Gas, with the use of "petroleum and its products."

Further information, and terms of sale of rights will be given, upon application to the Company. 348-1y

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W. W. Goodwin is the author of the History and Principles involved in the use of Lowe's Jet Photometer. Also Patentee and we are the SOLE MANUFACTURERS of the ORIGINAL and ONLY DIAL whereby the CANDLE POWER and PRESSURE can be instantly read, and all others are infringements

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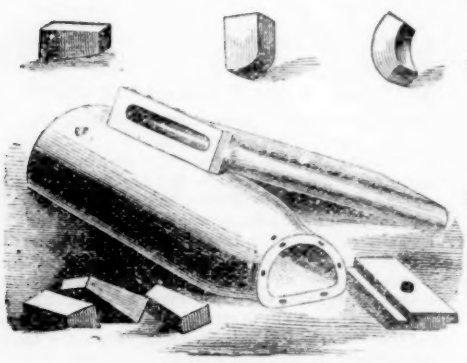

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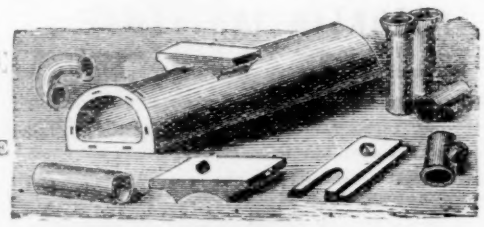

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We hereby caution all parties against making, vending, or using any GAS EXHAUST GOVERNOR that will be an encroachment of our patent.

The support and confidence of Gas Companies, so long enjoyed by us, encourage us to pursue the same undeviating course that has contributed to establish the character of our house, and with our extended experience and increased facilities, develop the latest improvement that Science can apply, in the construction of Gas Meters, etc., and thereby merit a continuance of the favors hitherto so liberally extended to us, always guaranteeing satisfaction.

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MANUFACTURER OF

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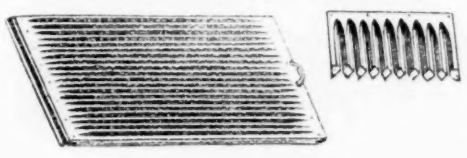

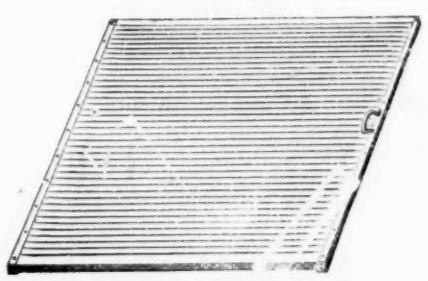

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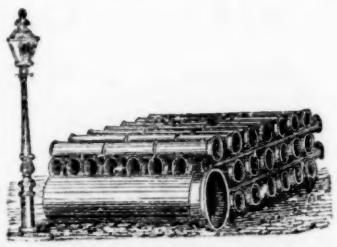

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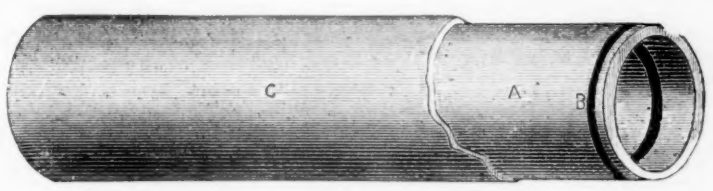
CHICAGO OFFICE, 646 WABASH AVENUE

SECTION OF GAS PIPE



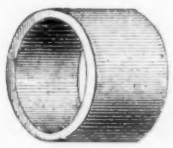


FIG. 2.

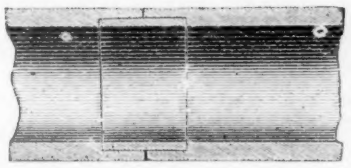


FIG. 3.

A—Cylinder of Wood. B—Band of Iron. C—Coating of Hydraulic or Asphaltum Cement.

FIG. 2.—Thimble for Connection. FIG. 3.—Horizontal Section and Connection.

Above is a cut of the

"WYCKOFF PATENT IMPERISHABLE GAS PIPE,"

manufactured by the NORTHWESTERN GAS AND WATER PIPE COMPANY.

This Pipe is made of White Pine, one inch to sixteen inches bore, in sections eight feet long rounded in a lathe, coated inside and out with Asphaltum, connected with a tenon, or socket, and a thimble joint, perfectly air and water tight, being driven together with cement furnished by the Company. When laid its cost is about one half that of Iron Pipe, and is UNQUESTIONABLY the best Gas conducting Main in use.

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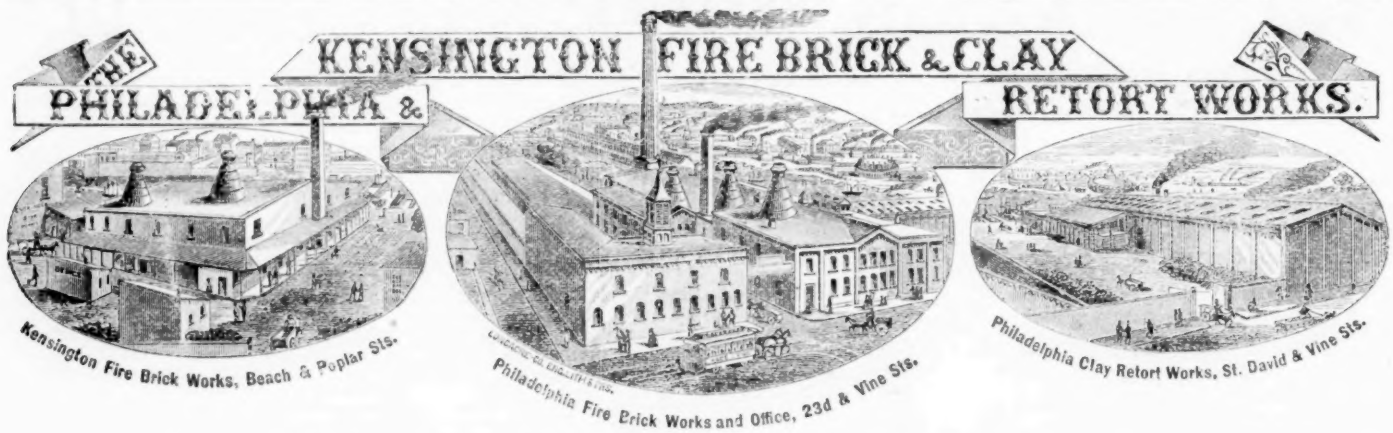
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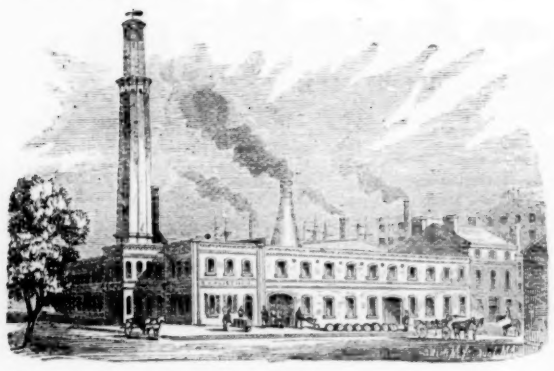

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We sell at figures which allow a much larger profit to the purchaser, with better light than any standard coal.

No gas material is at once so safe and so cheap. Our Asphalt is used in the manufacture of Varnish, Roofing, Ship Paint, Tiles, Pavements, Water Proof Paper, Cloth, and for all purposes where a coating is required that is unaffected by Water, Gasses, Alkalies, or Acids.

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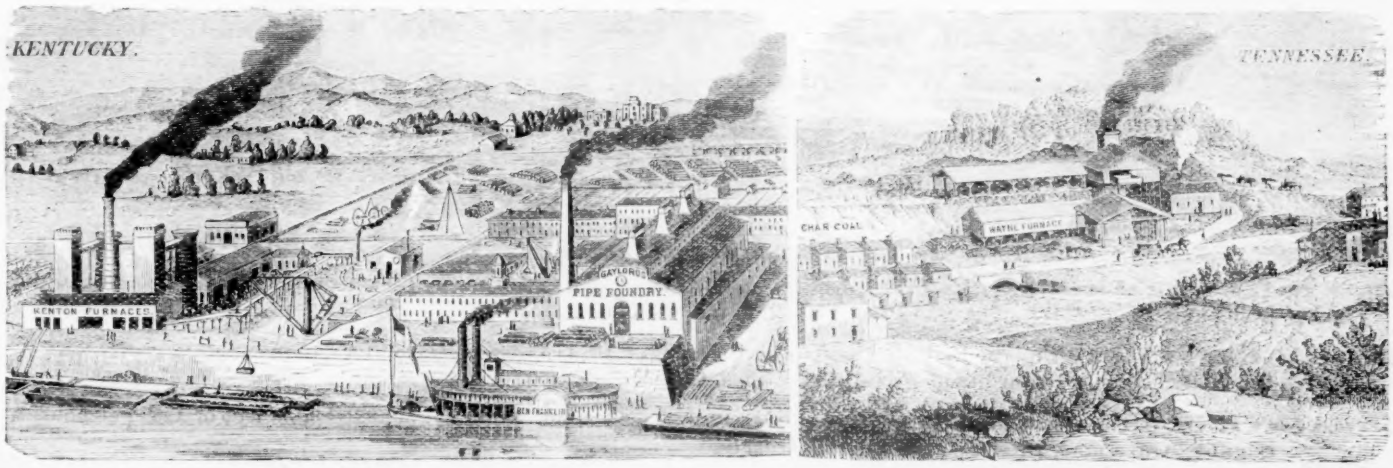

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FOR RELIEVING GAS RETORTS FROM PRESSURE.

Patented in the United States and Great Britain, June 1867 first patent for this purpose in the United States (but not presented to the public until fully tested). Now in successfu operation for six years, with most satisfactory results.

The many devices lately brought to the notice of the American public, to accomplish the same results are mostly old English contrivances tried and abandoned years ago, on account of the machinery, stuffing boxes, valves, levers, etc., necessary

But the extraordinary results obtained by the McIlhenny process, have induced some unprincipled persons to bring to the notice of the public, as *recent inventions of their own*, some of these old devices; their purpose seems to be simply to evade the patent.

This process is not only safe, simple and effective, but costs little to apply. The only machinery necessary is a one and a half inch stop cock, and a half inch stop cock to each bench No alteration in the old system is required. In fact, a Works operated with this process, can at any time be operated on the old pressure system, simply by closing the two stop cocks above mentioned. There is nothing to get out of order, nothing that requires special attention; no stuffing-boxes to pack and keep tight, no valves to keep clear of tar and pitch, no levers to lubricate, and no expense for a great amount of machinery.

The McIlhenny process challenges the world as regards yield and quality of gas.

For particulars apply to GEO. A. McILHENNY, Engineer of the Washington Gas-Light Co., Washington, D. C., or to WILLIAM YORKE, Engineer of the Portland Gas-Light Co., Portland, Me., who will take pleasure in corresponding with any one interested. 307-1y

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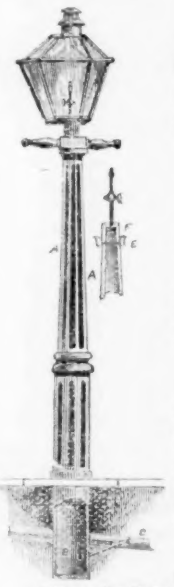

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Yours truly,
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Sec'y Wooster Gas-Light Co.

Address the Patentee,

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THOMAS T. TASKER JR. STEPHEN P. M. TASKER.

MORRIS, TASKER & CO.,

PASCAL IRON WORKS, PHILADELPHIA.

TASKER IRON WORKS, NEWCASTLE, DEL.

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Established 1821.

FOR GAS WORKS MACHINERY, ADDRESS OFFICE, FIFTH AND TASKER STREETS, PHILADELPHIA.

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EXHAUSTERS.—Exhausters and Compensators, By-Passes to pass from 4,000 to 150,000 Cubic feet of Gas per hour, with Engines, Governors, Pressure and Vacuum Guages.

SCRUBBERS.—Single or Multitubular Scrubbers, with Self-Acting Pumps for Ammonia Water.

WASHERS.—Cataract and Single and Multitubular Spray Washers.

CONDENSERS.—Single and Multitubular Air and Water Condensers.

PURIFIERS.—For Purifying from 1,000 to 2,000,000 cubic feet capacity daily, with either wet or dry Lime, or Oxide of Iron, and with either Ash Rivetted or Wrought or Cast Iron Lime Sieves.

CARRIAGES.—Movable Lifting Carriages for Purifiers, arranged either for Floor or Overhead use.

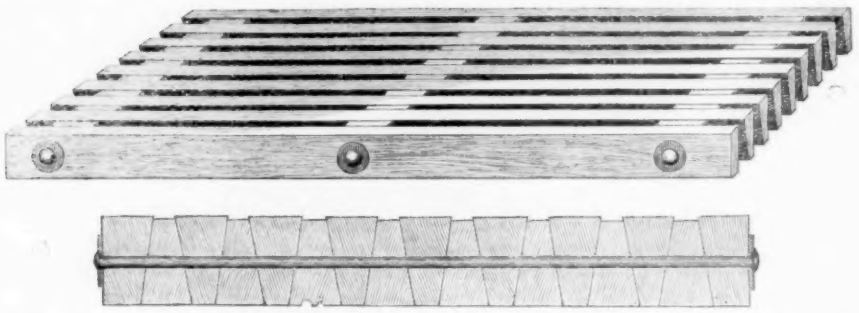
METERS.—Square and Round Meters of any capacity.

GAS HOLDERS.—Single Lift and Telescopic Gasholders, with Cast or Wrought Iron Suspension Frames.

GAS GOVERNORS.—Station Governors, with Regulating and Indicating Columns for Inlet and Outlet Pipes, also Dry Governors with Flexible Diaphragms for Underground Pipes.

STOP VALVES.—Double Faced Stop Valves for Gas or Water, from three inches to forty-eight inches diameter. These Valves are proved on both sides, with a heavy Water Pressure, Flange and Bell Pipes, Fittings and Drips of all descriptions. Steam Boilers and Hot Water Apparatus for Heating Building, and Gas Holder Tanks. Lamp Posts and Lanterns.

P. Munzinger's Patent Ash Lime Trays.



In use at the following Gas-Light Companies:

Pittsburg Gas Company, Pa.
Peoples Gas Company, Baltimore.
Lowell Gas-Light Company, Mass.
Lynn Gas-Light Company, Mass.
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Cumberland Gas-Light Company, Md.
Hartford City Gas-Light Company, Conn.
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Middletown Gas Company, Pa.
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Zanesville Gas Company, Ohio.

New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas-Light Company, Conn.
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Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
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